Tadej Todorović, Janez Bregant
Univerza v Mariboru

Sacrificing Natural Kinds: Fodor's Legacy and the Unity of Science

Introduction

The debate on the unity of science takes place at the intersection of the philosophy of science and the philosophy of mind. It was started by Hilary Putnam (Putnam 1975a; 1975b; 1975c) in a series of articles in the 1960s and 1970s, the aim of which was to demonstrate that the identity theory was false. The key concept in his argumentation was *multiple realization*, the idea that the same mental states are multiply realized by distinct physical states, thus blocking the reduction of the special sciences (e.g., psychology) to physics. In this way, the autonomy of the special sciences, especially psychology, sociology, economics, and cognitive science, was secured: if (natural) kinds in the special sciences cannot be reduced to (natural) kinds in physical sciences, they must be autonomous. This idea was made explicit and promoted by Jerry Fodor (1974; 1981; 1997), and has had a lasting impact on philosophy. However, such autonomy comes at a price: if the special sciences (i.e., higher-level sciences) are autonomous in the described sense, then physical descriptions of their predicates (i.e., lower-level physical sciences) do not contribute anything interesting or important to the higher-level explanations of the world. As Fodor puts it,

> /…/ whether the physical descriptions of the events subsumed by these generalizations have anything in common is, in an obvious sense, entirely irrelevant to the truth of the generalizations, or to their interestingness, or to their degree of confirmation or, indeed, to any of their epistemologically important properties /…/ (Fodor, 1974, 103)

However, this contradicts the success of cognitive science, which uses scientific methodologies, knowledge, and explanations from all the constitutive disciplines at different levels to yield new understandings of the world. Therefore, Fodor's autonomy of the special sciences prevents the intended explorative success of cognitive science.

DOI:10.4312/ars.19.1.33-50

The argument that multiple realization blocks the identity theory and consequently secures the autonomy of the special sciences was almost universally adopted throughout the better part of the 20th century, with the notable exceptions of Jaegwon Kim (Kim 1972; 1989; 1992) and David Lewis (Lewis, 1972), who, in their own ways, objected to multiple realization using the local reduction. However, their efforts did not enjoy much popularity until the very end of the 20th century and the beginning of the 21st, when multiple realization and Fodor's autonomy of the special sciences came under fire. William Bechtel and Jennifer Mundale (1999) were the first, arguing that philosophers apply inconsistent grains – a broader grain to establish the similarity of higher-level kinds and a finer grain to establish the difference among lower-level kinds. However, they argued that multiple realization disappears when one uses a consistent grain (Bechtel and Mundale, 1999). Other criticisms by Lawrence Shapiro (Shapiro, 2000), Thomas Polger (Polger, 2009), Colin Klein (Klein, 2008), and Toumas E. Tahko (Tahko, 2021) soon followed. While not at the centre of the multiple realization debate, the possibility that the falsity of multiple realization might spell an end to the autonomy of the special sciences did not go unnoticed. Nevertheless, few addressed Fodor's original argument for the autonomy of the special sciences, which will be the main purpose of this article. We will reevaluate his original position in the context of the recent shift in the field. First, we are going to (1) introduce the concept of multiple realization, followed by a (2) detailed analysis of key concepts, such as the distinction between natural and scientific kinds or the syntactic and semantic approach to scientific theories, related to the recent debate on the autonomy of the special sciences. Then we are going to (3) show why Fodor's argument for the disunity of science is flawed and (4) using Fodor's example of Gresham's law, articulate a plausible perspective which, by sacrificing natural kinds, maintains the autonomy of the special sciences and explains the success of cognitive science without the need to presuppose the disunity of science.

1 Multiple realization

The basic concept of multiple realization seems extremely simple. It consists of the multiple realization thesis, which, by Modus Ponens, leads to the conclusion that the identity theory (or psychophysical reductionism) is false:

1. (The multiple realizability thesis) (At least) some mental kinds are multiply realizable by distinct physical kinds.
2. If a given mental kind is multiply realizable by distinct physical kinds, then it cannot be identical to any one (of those) specific physical kinds.
3. (The anti-identity thesis conclusion) (At least) some mental kinds are not identical to any one specific physical kind. (Bickle; 2020)

The primary motivation for multiple realization was rejecting the identity theory (psychophysical reductionism), which was first articulated by Ullin T. Place (Place, 1956) and Herbert Feigl (Feigl, 1967), and is most succinctly summarized by John J. C. Smart (1959): "sensations are nothing over and above brain processes" (Smart, 1959, 145). According to the identity theory, mental states (such as pain, belief, desire, etc.) are identical to specific (neurological or neurochemical) brain states: any organism with a mental state M, e.g., pain, is in a specific physical state N and any organism with a physical state N is in a mental state M, e.g., pain. Therefore, being in pain is the same as being in a specific physical state. Multiple realization, as we know it today, was Putnam's doing. He developed it as an argument against the identity theory (Putnam, 1967): if the identity theory is true then different creatures (humans, reptiles, molluscs, etc.) that are in the same mental state, e.g., in pain, also must be in the same neurophysiological state, e.g., in X. Yet this looks counterintuitive given the diversity of nature and the process of evolution. It seems almost impossible that all creatures that have evolved differently would have the same neurophysiological realizers. In standard form:

1. If the identity theory is true, then different beings must be in the same neurophysiological state while experiencing the same mental state (for, according to the identity theory, pain is identical to one specific physical state/realizer).
2. Given all we know about nature and evolution, it seems almost impossible for different beings to be in the same neurophysiological state while experiencing the same mental state.
3. The identity theory is false.

As it stands, the argument is empirical. Putnam never gives any example that different beings are *actually not* in the same physical state when, e.g., they feel pain, but merely assumes that this is unlikely to exist given our knowledge about nature. Such an armchair prediction cannot serve as a reasonable justification for the second premise, which is crucial for the denial of the identity theory, and, moreover, it turns the philosophical argument into a scientific problem. Now, it is up to scientists to determine whether the second premise is true or false. However, even cognitive scientists would have a problem here, as the very nature of mental states (or at least a significant portion of them, speaking about phenomenal states) is subjective and empirically unverifiable. This characteristic of mental states requires an interdisciplinary solution: the philosophical (conceptual) and the scientific (empirical) aspects; neither armchair philosophy nor empirical experiments are sufficient to address the issue.

2 Autonomy of the special sciences in the 21st century

The goal of logical positivism[1] was the ultimate unity of science, i.e., the reduction of laws and theories of higher-order sciences to the one fundamental science, i.e., physics.

1 Carnap, 1937; Coffa, 1991; Creath, 2023; Friedman, 1999; Hempel, 1966; Uebel, 2024; Winther, 2021

The success of such an endeavour would mean the redundancy of the special sciences: since the lower-level science predicates could be used in the explanations of the world, there would be no need for the higher-level science predicates. In fact, the unity of science would make special sciences "quasi" sciences, which is not easy to adopt.

The discussion is marked by the two following concepts: basic or fundamental (primary or lower-level/order) sciences and special (secondary or higher-level/order) sciences. The basic (also hard) sciences typically include physics (and chemistry to some extent[2]), while the special sciences typically include biology, social sciences, cognitive sciences, etc. (Cat, 2024). A precise definition for either of the terms is hard to give. Usually, however, the definition of the special sciences is negative, e.g., the term applies to all sciences other than physics (which does not tell us anything about their characteristics). One potential difference is offered by Fodor (1974), who distinguishes the special from the basic sciences in that the laws of the latter do not involve exceptions, whereas the laws of the former do. In the paper, the term *ceteris paribus* laws (Latin for "all other things being equal") is used to refer to laws with exceptions, i.e., special science laws.

This difference, Fodor argues, leads to the conclusion that special sciences cannot be, even in principle, reduced to basic sciences, which secures their autonomy. It also prevents interdisciplinary approaches like cognitive science because the differences between the "/…/ physical descriptions of the events /…/ [are] entirely irrelevant to /…/ their epistemologically important properties" (Fodor, 1974, 103). The autonomy of the special sciences means that their higher-order (e.g., mental) predicates have causal powers independent from their lower-order (e.g., physical) predicates "/.../ [and] that these [secondary] properties can typically have multiple physical realizations, they are not identical to physical properties /.../" (Menzies & List, 2010, 108). Let us explain this using Fodor's example.

He begins his objection to the unity of science with the commonsense assumption that "[e]very science implies a taxonomy of the events in its universe of discourse" (Fodor, 1974, 101). In other words, every science (whether basic or special) is constructed with a theoretical and observational vocabulary that allows the events studied by the science to be described by the laws of the science. So, the science postulates predicates with which the events studied can be identified. Fodor defines such predicates as natural kinds: "P is a natural kind predicate relative to S [science] iff S contains proper laws of the form $Px \rightarrow \alpha x$ or $\alpha x \rightarrow Px$" (Fodor, 1974, 102). Take a simplified example: hydrogen (H_2) is a natural kind if and only if (within chemistry) it appears as a variable in the laws of chemistry (recall how to solve various chemical equations involving hydrogen). Natural kind predicates are predicates that appear as variables in the proper laws (of a given science).

2 Whether chemistry can be counted as a basic science is subject to discussion, although Fodor (1974) accepts it as such.

Natural kinds in the special sciences

A short detour into the debate on natural kinds cannot be avoided at this point. Plato (1972) famously started the debate by characterizing natural kinds as predicates that "carve nature at its joints" (Plato, 1972, 265e), expressing the idea that there are some predicates that classify in accordance with the "objective" structure of the world and not in line with human interests. Objective, in this sense, means independent of human interests. Today, there is an extensive discussion on whether natural kinds exist (realism vs eliminativism) (Bird & Tobin, 2024), what they are (weak realism, strong realism, essentialism) (Bird & Tobin, 2024), whether the concept is useful (Hacking, 2007; Ludwig, 2018), and, most important for this paper, whether the concept applies to the special sciences (Bird & Tobin, 2024). This is because one of Fodor's first moves in his arguments is to assume that special science predicates are natural kinds: "If reductivism [psychophysical reductionism] is true, then every natural kind is, or is co-extensive with, a physical natural kind" (Fodor, 1974, 102). Whether special science predicates operate with natural kinds or not is at the very crux of the debate, yet Fodor does not offer any justification for his claim, and this has been criticized:

> Fodor's focus on predicates is problematic though, for why should we think that any (or all) predicates of the special sciences should correspond to genuine natural kinds? Indeed, we should not think so /…/ I take this to be a serious flaw in Fodor's original criticism of reductionism. (Tahko, 2021, 15)

Syntactic and Semantic View of Scientific Theories

Fodor was probably able to uncontroversially claim this due to the common understanding of how scientific theories were built at the time. Then the *syntactic view* dominated the discussion, which, being a remnant of logical positivism, required solely ontologically committing terms, i.e., terms that correspond to or exist in the actual world, as being part of scientific theories. The syntactic view understood theories as built only from terms (predicates like "atom" or "protein") and sentences (laws, axioms, etc.), whereby predicates that appeared in scientific laws also existed. However, today we know that sciences often use predicates that are not real in any sense of the word, i.e., they do not exist at all, such as frictionless planes or ideal gases, yet they appear in scientific laws and explanations. This contradiction led to the rise and major adoption of the *semantic view*, where theories are understood as sets of models and not sentences (Frigg, 2006; Halvorson, 2012). According to the semantic view, it is the models, and not sentences, which are, *in some relevant aspect*, identical to the actual world. As van Fraassen (2008) puts it:

> /…/ phenomena are, from a theoretical point of view, small, arbitrary, and chaotic—even nasty, brutish, and short, one might say—but can be understood as embeddable in beautifully simple but much larger mathematical models. (Fraassen, 2008, 247)

By adopting the semantic view, the existence of scientific predicates in the actual world is no longer self-evident. Some might correspond (exist), whereas some might not (ideal gas). Even if scientific models correspond to the world, they only do so in some aspect(s), not entirely. The first important conclusion is that using a predicate in science does not automatically prove its existence, something that Fodor seemed to presuppose.

Scientific kinds vs. natural kinds

Another consequence of the semantic view has to do with natural kinds: if models only correspond to reality in some relevant aspects, how are they "natural", i.e., do they comply with some objective classification, independent of human interests? Significant progress has also been made as well with regard to this question. For some time, the worry was that the non-naturalness of kinds implies their non-existence, i.e., if a kind is not natural, it does not exist. However, as Devitt points out (Devitt, 2011), this is due to confusing *non-arbitrariness* with *mind-independence*. When we claim that a kind is not natural, we do not claim that it only exists in our head (that it is not mind-independent and objective); we only claim that it is arbitrary. Devitt (2011) uses "grugru" as an example: grugru is anything that is an acid, a river, or a bachelor. The kind grugru actually is is entirely arbitrary, and thus not a natural kind, yet acids, rivers, and bachelors exist (mind-independently): "/… / *existence, unlike naturalness, does not come in degrees* /…/ the requirement that a kind be natural is *quite distinct from* the requirement that entities of that kind exist objectively and mind-independently" (Devitt, 2011, 159).

This fits the semantic view: if sciences invoke non-existent models or kinds for explanatory purposes, they can also invoke arbitrary (non-natural) but existent kinds for the same job. Many philosophers in the field moved away from the notion of a natural kind because non-naturalness implies non-existence, which is not the case. Judith H. Crane (2021) highlights the tension between the natural kinds project in the philosophy of language and philosophy of science: the first deals with metaphysics and reference, the second with the epistemological role of kinds, i.e., their role in explanations, inferences, and causality (Crane, 2021). For this reason, she proposes the term *scientific kinds* for predicates in sciences instead of natural kinds. Other authors arrived at similar conclusions. For example, P.D. Magnus (2012) abandons the idea that scientific kinds must be related to causal structures, and argues that they are *domain--relative categories* that allow scientific research to be inductively and explanatorily successful (Magnus, 2012); Muhammad Ali Khalidi (2013) uses the term natural kinds but believes that they do not need to be independent of human interests (Khalidi, 2013); Laura Franklin-Hall (2015) articulates a natural kinds concept according to which the categorization of kinds is ultimately *subjective* (Franklin-Hall, 2015); and Hasok Chang (2015) understands natural kinds as a concept that is *useful enough* for research in the natural sciences (Chang, 2015). To sum up, the debate on scientific kinds oscillates between two claims: a weaker one arguing that scientific predicates are arbitrary, yet existent, and a stronger one arguing that scientific kinds are arbitrary and non-existent. Since the weaker claim, well established by the abovementioned authors, is sufficient for our purpose, i.e., preserving the autonomy of the special sciences claim sacrificing natural kinds, it will be adopted in the further debate while the stronger claim will be left aside.[3]

The overarching conclusion is that scientific predicates do not need to be natural or even ontologically committing (existent) to perform their epistemological roles. Most importantly, it does not follow that just because science uses a specific predicate or kind in its laws that that kind exists or that it is natural. Furthermore, non-naturalness does not imply non-existence, only arbitrariness: scientific kinds exist, yet they are not natural, only arbitrary (to various degrees). With these conclusions in mind, we can finally address Fodor's main argument against the unity of science.

3 Fodor's argument for the disunity of science

As we have established, Fodor (prematurely) identifies the predicates that scientists use as (non-arbitrary and existent) natural kinds. Since "bridge laws", i.e., "statements linking concepts of the reduced theory to concepts of the reducing theory" (Horgan, 1978, 227), which are used to reduce special science to basic science, express identity, every natural kind must be identical with, or coincide with, a physical natural kind. Fodor (1974) gives three reasons why this is false:

> /…/ (a) interesting generalizations (e.g., counter-factual supporting generalizations) can often be made about events whose physical descriptions have nothing in common, (b) it is often the case that whether the physical descriptions of the events subsumed by these generalizations have anything in

3 Our view is compatible with both the weaker and stronger claims. Nevertheless, it seems that sciences employ both, existent and non-existent predicates. Thus, we believe that while (most) scientific predicates are probably existent yet arbitrary, there are presumably many obvious cases of scientific predicates in all sciences that are both, non-existent and arbitrary, e.g., an ideal gas. The existence of a particular scientific predicate would thus have to be decided on a case-by-case basis.

> common is, in an obvious sense, entirely irrelevant to the truth of the generalizations, or to their interestingness, or to their degree of confirmation or, indeed, to any of their epistemologically important properties, and (c) the special sciences are very much in the business of making generalizations of this kind. (Fodor, 1974, 103)

We will not dispute (a) that interesting generalizations can be made about events with very different physical descriptions or (c) that special sciences make exactly such generalizations about exactly such events, but we will dispute (b) that physical descriptions (or physical realizers) are entirely irrelevant to the truth of such generalizations. After all, it is the interplay of different methodologies and theoretical frameworks of various disciplines that makes disciplines like cognitive science so valuable and successful. Cognitive science, in particular, has discovered how valuable the reciprocal interdisciplinary dialogue is for refining various concepts in the constituent disciplines to reach a new and more comprehensive (unified even) understanding of the world.

Let us use Fodor's example from economics, i.e., Gresham's law, to demonstrate a flaw in his argument for the disunity of science: "/.../ the reasons why economics is unlikely to reduce to physics are paralleled by those which suggest that psychology is unlikely to reduce to neurology" (Fodor, 1974, 104). Gresham's law states that "bad money drives out good [money]" (Britannica, 2015). Suppose there are two forms of currency made of metals of different values in circulation but having the same nominal value. In that case, money made of the less valuable metal will be used for payments and kept in circulation, whereas money made of the more valuable metal will be stored away and kept out of circulation. Fodor chooses Gresham's law because it seems impossible to find a single physical description of all instantiations of "monetary exchange" (monetary exchange could be realized by such diverse physical kinds as strings, shells, metals, cryptocurrencies, paper, plastics, etc.). Suppose various physical realizers (metals, shells, etc.) realize the same phenomenon (Gresham's law). In that case, the phenomenon is multiply realizable (not reducible), and the physical realizers (metals, shells, etc.) have nothing to do with the laws of economy (economy is independent).

Fodor (1974) argues that it seems unlikely that, given the range of different monetary exchanges, there could be a single physical predicate that could satisfy the description of such a law: cheques are/were part of monetary exchange, in some places, debit and credit cards, shells on a string are part of monetary exchange, etc.:

> What are the chances that a disjunction of physical predicates which covers all these events (i.e., a disjunctive predicate which can form the right-hand side of a bridge law of the form 'x is a monetary exchanged...') expresses a physical

> natural kind? /…/ The point is that monetary exchanges have interesting things in common; the Gresham's law, if true, says what one of these interesting things is. But what is interesting about monetary exchanges is surely not their commonalities under physical description. A natural kind like a monetary exchange could turn out to be co-extensive with a physical natural kind; but if it did, that would be an accident on a cosmic scale. (Fodor, 1974, 103)

4 The unity of science after all

Let us first recontextualize his claim, given the debate on scientific theories and natural kinds outlined above. Following the (old) syntactic view, a predicate like monetary exchange exists because it is a predicate in a scientific (economic) law. In virtue of the same fact, it is also a natural predicate. This is problematic for psychophysical reductionism and the unity of science because it seems unlikely that only a single physical (or lower-level) kind will realize such a (higher-level) kind. Furthermore, if a variety (disjunction) of physical realizers is discovered, they would be arbitrary and not form a natural kind. This would be a classic example of multiple realization. A further problem for the unity of science concerns the properties of basic and special science laws: basic laws do not have exceptions, whereas special science laws are *ceteris paribus*, i.e., they have exceptions. The defenders of the unity of science must answer the following question: How is it possible to reduce *ceteris paribus* laws with exceptions via exceptionless bridge laws to physical laws without exceptions? This is the challenge of Fodor's "master" argument against psychophysical reductionism and the unity of science: either special science laws do not have exceptions (which does not seem to be the case) or basic science laws do have exceptions. Because both options seem wrong, the original premise (the identity theory or the reductionist model) must be false.

> In short, given the reductionist model, we cannot consistently assume that the bridge laws and the basic laws are exceptionless while assuming that the special laws are not. /.../ We can get out of this (salve the model) in one of two ways. We can give up the claim that the special laws have exceptions, or we can give up the claim that the basic laws are exceptionless. I suggest that both alternatives are undesirable. (Fodor, 1974, 110–111)

However, the argument works only if we adopt the (old) syntactic view and Fodor's understanding of natural kinds. If we adopt the (new) semantic view, special science laws and predicates refer to models and not the actual world. Furthermore, the predicates are not natural but (arbitrary) scientific kinds. The science-specific model is then either idealized and does not exist (like the ideal gas), or it is isomorphic to the actual world only in some aspect under specific background conditions, i.e., it is arbitrary, not natural. In this scenario, the models serve the explanatory role that sciences require but remain consistent with psychophysical reductionism: either physical descriptions do not realize the actual model (because it is idealized and non-existent) or a disjunction of physical descriptions merely realizes an arbitrary aspect of reality. This also takes care of multiple realization: a multiply realized idealized and non-existent model is easily accommodated by reductionism. In contrast, a domain-specific arbitrary model will not be multiply realized, which we will show below. Such a perspective also fits the recent "inverse" understanding of higher-order predicates, articulated by Gualtiero Piccinini and Corey J. Maley (2014). Historically, we have understood higher-order predicates, i.e., special science predicates, as something more than the phenomenon itself, but the opposite seems to be the case. Higher-order predicates should be understood as specific aspects of the entire phenomenon in specific background conditions:

> /.../there is something less, not more, to an object's possessing a higher-level property. The worry that higher-level properties are redundant disappears when we realize that higher-level properties are subtractions of being, as opposed to additions to being, from lower-level properties. Multiple realizability is simply the relation that obtains when there are relevantly different kinds of lower-level properties that realize the same higher-level property. /…/ Thus, a higher-level property is a (partial) aspect of a lower-level property. (Piccinini & Maley, 2014, 130–131)

Let us now try something new and analyse Fodor's case of Gresham's law in terms of the semantic view. Fodor makes a bold claim regarding possible realizers of Gresham's law, claiming that cheques and shells could, in principle, realize it. We believe that seems rather unlikely – in fact, Gresham's law would almost certainly not work if we used any material except metal as currency. The law assumes that coins derive value from their intrinsic worth as metals (Velde, Weber & Wright, 1999, 293). Take two silver coins with the same value, A and B, where B has merely 90% of silver compared to A. Both have the same shape and imprint, so a layperson could not tell the difference between the two. In the early 1390s, the Duchess of Brabant in Belgium chose to establish a new mint close to her rival, the Count of Flanders. This mint was tasked with producing coins that closely resembled the Count's but contained slightly less metal (Dutu, Nosal & Rocheteau, 2005, 2). Simon La Faucille, the Count's monetary officer, stated that "the difference between the Count's coin and the Duchess' is so minor that ordinary people will, and already do, accept your penny as being equal in value to the previous one, even though it is worth two esterlins less" (Dutu, Nosal & Rocheteau, 2005, 2). Experts (mint masters) were among the few who could tell the difference between the two and exploit this for personal gain: melting coin A, reforging it as coin B, and pocketing the difference. Removing the undervalued coins from circulation made sense because they could be reforged, and a profit could be made. Metals are unique in this sense because they can be reforged and recoined as lighter coins:

> /…/ money was made of precious fungible metals like gold and silver that good, undervalued coins could be melted and recoined as lighter ones. But modern fiat systems do away with these two important ingredients: The intrinsic value of coins, bills, and deposits is zero, and good currencies cannot be melted. (Dutu, Nosal & Rocheteau, 2005, 2)

Could Gresham's law be reproduced using currency made of different materials? It seems unlikely. To explain Gresham's law, explanations and insights from various disciplines are invoked: chemistry is required to account for the fungibility of metals, psychology for the avarice of people, economy for the creation of the market based on the monetary exchange, and history for providing the appropriate context, e.g., for Gresham's law to apply, "the legal ratio must be enforced by the government" (Dutu, Nosal & Rocheteau, 2005, 2). It seems that changing any of the variables might influence the result, especially changing the most important variable, i.e., the material of the coins. Since shells, plastics, and paper cannot be melted and reforged, why would we expect the same law to hold? Moreover, Gresham's law does not even always hold under the above conditions, and economists are still discussing which conditions must be met in order for it to do so (Rolnick & Weber, 1986; Velde, Weber & Wright, 1999; Sparavigna, 2014). If Gresham's law seems to apply only to metals under specific conditions, why are we convinced that it can be generalized to shells, cheques, or cards in all conditions?

That Gresham's law does not always hold (even for metals) is not wholly disastrous from Fodor's viewpoint: after all, special science laws are *ceteris paribus*. Nevertheless, he does not explain why this is the case; he does not explain why they have exceptions. If the predicates in such laws are natural kinds, i.e., they exist, and such laws are proper, why do they allow for exceptions? However, if we adopt the semantic view, as we propose, the answer to this question is at hand. Understanding Gresham's law as an idealized model allows for discrepancies between the model and reality: knowledge from other disciplines will reveal why the law did not hold in given conditions and identify those that must be met, along with necessary physical mechanisms. This also takes care of multiple realization because a physical description of all metals is available, making metals a single and not multiple physical realizer of Gresham's law:

> Metals contain free electrons in the outer shell of their atoms, meaning that these electrons are not associated with a specific atom nor form part of a specific chemical bond, thus allowing them to move freely and resulting in the production of an electric current. This explanation applies to all members of the kind-metal and allows us to understand why each and every instance of that kind exhibits electrical behaviour. (Seifert, 2023, 13)

Admittedly, the semantic view does imply a certain unrealism or fictionalism regarding laws and predicates in the special sciences: if all models and predicates used are idealized, then they, in fact, do not exist. Note, even if it were the case that special science predicates are non-existent, this would not jeopardize their objectivity. While scientific kinds in the special sciences are non-natural (arbitrary), this is not a reason to believe that special science laws have become too relativized within such a framework. Remember, physics also utilizes idealized models, and no one considers it less legitimate because of that.[4] Regardless, we believe that some (but not all) scientific models and kinds do describe the actual world (they are existent), which holds even for Gresham's law. To secure the reality of such predicates, we believe the price that must be paid comes in revoking their naturalness: by understanding scientific models and kinds as arbitrary, where the models only represent some domain-specific aspect of reality. In this sense, Gresham's law can be understood as a domain-specific (arbitrary) model, isomorphic to the actual world, but only under specific background conditions. Since the background conditions are often unspecified in the sciences, this gives rise to the illusion of multiple realization. Such an understanding of Gresham's law also explains the *ceteris paribus* nature of special science laws: they have exceptions because they only hold under specific background conditions. By combining knowledge, methodologies, and approaches from various disciplines, we can explain why they do not work in some contexts, just like we did in the case of Gresham's law.

From a methodological point of view, this guarantees the success of cognitive science: it is profitable because it interacts with various disciplines that examine different aspects of the same phenomenon. Every one of them focuses on their own (relative) domain. Cognitive science can, by synthesizing such multiple aspects, yield new scientific insight. By examining, e.g., phenomenon X from the perspectives of different disciplines, cognitive science can unveil and articulate the specific background conditions of X and thus explain why laws in one science have exceptions and in another do not. Just like exceptions in Gresham's law are explained away by referring to the insights and background conditions examined by other sciences than economics. If

4 We thank the anonymous reviewer for highlighting the need to address this point.

Fodor's ontological picture were accurate, sciences would merely deal with level-specific phenomena, and such insights would not be possible. However, as demonstrated by our analysis of Gresham's law, Fodor's ontological picture is not true, which also explains why the success of cognitive science at explaining the world does not come as a surprise.

5 Conclusion

The paper discussed the validity of Fodor's argument for the disunity of science, which goes against scientific projects, such as cognitive science, that successfully merge and adopt perspectives and methodologies from various disciplines to arrive at new and exciting knowledge about the world. We have introduced the historical context that enabled the widespread adoption of Fodor's conclusion in favour of the disunity of science. This was followed by an up-to-date analysis of the key assumptions on which his argument rests: the syntactic view of scientific theories and his position on natural kinds. We have shown that new developments in the field, i.e., the semantic view of scientific theories and the concept of scientific kinds, render his argument against the unity of science obsolete. By examining his case study of Gresham's law and adopting the semantic view of scientific theories, we have articulated a plausible, unified picture of the world, which also answers the challenge of multiple realization and explains why laws in the special sciences have exceptions. By understanding cases like Gresham's law as either an idealized or (domain-relative) model, and special science predicates as scientific (arbitrary, yet existent) kinds, we enable a theoretical framework for the unity of science that explains the success of cognitive sciences and interdisciplinarity in general. By sacrificing the naturalness of such predicates, we retain their existence, (relative) autonomy, and indispensability. Our proposal, therefore, explains the success of interdisciplinarity and collaboration among disciplines, such as cognitive science, while keeping a unified, ontologically simple picture of the world, where all the studied phenomena are, in the end, nothing more and nothing less than physical phenomena.

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Sacrificing Natural Kinds: Fodor's Legacy and the Unity of Science

Keywords: multiple realization, natural kinds, unity of science, special sciences, Fodor

The article reevaluates Jerry Fodor's key argument for the autonomy of the special sciences, which rests on the notion of multiple realization and the claim that special science predicates must be natural kinds. After outlining how Fodor's view was shaped by the "syntactic" conception of scientific theories, it shows that the recent "semantic" approach in scientific theories challenges the idea that special science kinds must be natural and ontologically committing. On the semantic account, scientific models often invoke idealized or domain-specific predicates that do not have to be natural. We use Fodor's example – Gresham's law – to articulate a semantic perspective that preserves the unity of science: higher-level explanations can remain useful, real, and relatively autonomous without irreducible natural kinds. By "sacrificing" natural kinds, we retain the explanatory powers of the special sciences, create a simpler ontological picture of the world, and justify the *modus operandi* of the sciences, such as cognitive science, where knowledge from the different levels or disciplines that constitute it informs and refines our overall understanding of the world.

Žrtvovanje naravnih vrst: Fodorjeva zapuščina in enotnost znanosti

Ključne besede: večvrstna realizacija, naravne vrste, enotnost znanosti, posebne znanosti, Fodor

Članek znova ovrednoti ključni argument Jerryja Fodorja za avtonomijo posebnih znanosti, ki temelji na konceptu večvrstne realizacije in predpostavki, da morajo biti predikati posebnih znanosti naravne vrste. Po kratkem orisu »sintaktičnega« pojmovanja znanstvenih teorij, ki je oblikovalo Fodorjev vidik, pokaže, da novejše »semantično« pojmovanje spodkopava idejo, da morajo biti predikati posebnih znanosti nujno naravni in ontološko zavezujoči. Semantični pristop namreč poudarja, da znanstveni modeli pogosto uporabljajo idealizirane ali domensko specifične predikate, za katere ni nujno, da so naravni. S pomočjo Fodorjevega primera – Greshamovega zakona – oriše takšno semantično perspektivo, ki ohranja enotnost znanosti: razlage višjih ravni lahko ostanejo uporabne, realne in razmeroma avtonomne tudi brez nereducibilnih naravnih vrst. Z žrtvovanjem naravnih vrst tako ohranimo pojasnjevalno moč posebnih znanosti, ustvarimo preprostejšo ontološko sliko sveta in upravičimo *modus operandi* znanosti, kot je kognitivna znanost, kjer znanje z različnih ravni oziroma iz različnih disciplin, ki jo sestavljajo, bogati in izpopolnjuje naše skupno razumevanje sveta.

About the authors

Dr Tadej Todorović is a Teaching Assistant of philosophy and linguistics with a PhD in philosophy from the University of Maribor, Slovenia, focusing on the philosophy of mind, science, critical thinking, and artificial intelligence. His area of interest includes the philosophy of language, with an interest in speech act analysis in pragmatics, aesthetics, and animal ethics. He is also the editor of the Slovenian philosophy journal *Analiza*, technical editor of the international philosophy journal *Acta Analytica*, and a member of the Ethics and Standards Committee of the *Journal of Innovative Pedagogy*.

Email: tadej.todorovic@um.si

Dr Janez Bregant is an Associate Professor of philosophy at the Faculty of Arts, University of Maribor. His area of interest includes philosophy of mind, critical thinking, philosophy of art, and artificial intelligence. He is co-editor of *Contemporary Perspectives of Society: Artificial Intelligence at the Intersection of Sciences* (University of Maribor Press), co-author of *Virtual Teacher: Cognitive Approach to e-Learning Material* (Cambridge Scholars Publishing), and author of *Thought as a Cause* (Faculty of Education Maribor). He is a member of the Ethics and Standards Committee of the Journal of Innovative Pedagogy and currently Head of the department of Philosophy at University of Maribor.

Email: janez.bregant@um.si

O avtorjih

Dr. Tadej Todorović je asistent za filozofijo in lingvistiko na Filozofski fakulteti Univerze v Mariboru. Poudarek njegovega raziskovanja je na filozofiji duha, filozofiji znanosti, kritičnem mišljenju in umetni inteligenci, ukvarja pa se tudi s filozofijo jezika, estetiko in etiko živali. Je urednik slovenske filozofske revije *Analiza*, tehnični urednik mednarodne filozofske revije *Acta Analytica* ter član Odbora za etiko in standarde pri reviji *Revija Inovativna pedagogika*.

E-naslov: tadej.todorovic@um.si

Dr. Janez Bregant je izredni profesor za filozofijo na Filozofski fakulteti Univerze v Mariboru. Ukvarja se s filozofijo duha, kritičnim mišljenjem, filozofijo umetnosti in umetno inteligenco. Je sourednik monografije *Sodobne perspektive družbe: umetna inteligenca na stičišču znanosti* (Univerza v Mariboru), soavtor knjige *Virtual Teacher: Cognitive Approach to e-Learning Material* (Cambridge Scholars Publishing) in avtor monografije *Misel kot vzrok* (Pedagoška fakulteta Maribor). Je član Odbora za etiko in standarde pri reviji *Revija Inovativna pedagogika* in trenutno predstojnik Oddelka za filozofijo na Univerzi v Mariboru.

E-naslov: janez.bregant@um.si